CHAPTER 3

SOIL STABILIZATION PRACTICES

VEGETATIVE

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VEGETATIVE

BMP 3-1
SEEDING PRACTICES

DEFINITION

Seeding practices include a variety of techniques which result in the sowing or planting of seeds. Common practices include broadcast seeding (hand or mechanical), drill seeding, aerial seeding and hydroseeding.

PURPOSE

The primary purpose of seeding a site is for soil stabilization through the establishment of a vegetative cover. Related objectives include: to reduce raindrop impacts and surface water flow, to reduce erosion from wind and water and to enhance aesthetics and the natural environment.

APPLICABILITY

Seeding practices are applicable to any surface disturbance site requiring revegetation or reclamation. Slopes must be mechanically stabilized prior to seeding as vegetation alone will not stabilize a slope. Drilling seeding is typically limited to slopes of 3:1 or flatter, but it is the most successful practice. Hydroseeding is most effective in steep slope situations which have little or no access (e.g. road cut or fill slopes, mine waste dumps, etc). Broadcast seeding is less expensive but requires approximately twice the amount of seed over drill seeding. Aerial seedings are typically applied on large areas with no access, such as forest or rangeland fires.

PLANNING CRITERIA

The establishment of vegetation is the most efficient and cost effective form of erosion control and soil stabilization. Once established vegetation absorbs raindrop impact and prevents the mobilization of soil particles. Vegetation prevents erosion while other treatments such as filter fabric, sediment basins or filter strips only treat the sediment mobilization process.

Seeding practices should be selected based upon the specifics of the site and the expertise of a qualified professional should be consulted. Typically economics, site topography and/or access are controlling factors in the selection process. Seeding practices should also be tailored to the plant material seed being applied (i.e. grasses, forbs, shrubs). Tree species are typically planted from container stock after establishment of a grass/forb/shrub cover. Seeding practices are usually incorporated within a combined structural and vegetative approach to soil stabilization. Vegetation alone will not stabilize a slope. Other nonvegetative techniques are also utilized to enhance the success of a seeding such as mulches, netting, matting and chemical tacifiers.

Irrigation will assist in achieving a good seed/soil contact and is critical to plant establishment on dry sites. Over watering will cause washing and runoff, thus potentially transporting seed down gradient.

METHODS AND MATERIALS

Vegetation or reclamation specialists should be consulted regarding mulch application rates, plant species selection, seeding rates, etc. to ensure a successful project.

Broadcast seeding (hand or mechanical): Broadcast seeding can be accomplished by hand held seeders or a mechanically driven seeder typically mounted on a tractor or ATV vehicle. The seed mix is placed in a hopper, adjustments are made for the size of the seed and rate of application, and the seeder is operated by a hand crank or motor while walking or driving over the areas to be seeded. Broadcast seeding typically requires twice the amount of seed to cover the same given area as a drill seeder due to wind drift, wildlife consumption and lack of good soil to seed contact.

Drill seeding: Drill seeding requires the use of a Range drill or equivalent depending on the condition of the site. Drill seeders are pulled behind a tractor or bulldozer and actually place the seed to a pre-determined depth. The seed is then covered by the drill mechanism or a chain drag is utilized to cover the seed behind the drill. Drill seeding provides the best seed to soil contact and correspondingly the highest success rate.

Aerial seeding: Aerial seeding is conducted by helicopter or fixed wing aircraft and can cover large areas of inaccessible terrain. It is the most efficient method for large disturbance areas such as forest or rangeland fires. Germination success is usually low given wind drift, soil conditions, and poor seed to soil contact, but application timing can greatly improve success. If seeding can occur shortly after a wildland fire and before a soil crust is formed, success is greatly improved.

Hydroseeding: The wood fiber and water mixture are well agitated in a large tank and then blown through a hose and nossel by compressed air. The apparatus is typically truck or trailer mounted and has sufficient capacity to complete several acres at a time. Mulch application rates and/or seeding rates depend upon the site specifics of the project area and the project goals. Typically irrigation is necessary to successfully establish a vegetative cover with hydroseeding.

MAINTENANCE

Seeded areas require regular inspection and potentially reapplication if necessary. The treatment areas should be protected from foot or vehicle traffic until vegetation is well established. This may require fencing, barriers and signing.

EFFECTIVENESS

Selection of the appropriate seeding practice for a specific site coupled with proper plant material selection, application rates, application timing and maintenance will result in the most effective method of soil stabilization. Coupled with other revegetation techniques seeding and the resulting vegetation will provide long term soil stability.

BMP 3-2
WATTLING

DEFINITION

Wattling is a revegetation technique consisting of placing bundles of willow cuttings in shallow trenches, on the contour of either cut or fill slopes.

PURPOSE

To stabilize cut or fill slopes, to stabilize the soil surface, to reduce the velocity of surface runoff, to trap sediment, to increase infiltration, and to establish vegetation.

APPLICABILITY

Applicable to surface disturbances involving cut or fill slopes. Slope lengths can be interrupted by rows of wattling. Wattling is not applicable to excessively steep slopes. As a type of revegetation, wattling is applicable on moist sites or seeped areas.

PLANNING CRITERIA

Wattling is a valuable method to help achieve surface stability on a cut or fill slope which is near its angle of repose, but continues to erode due to surface runoff. Wattling bundles can vegetatively root and sprout and continue to stabilize slope surfaces as a revegetation planting. Rooting and sprouting will occur if adequate moisture is available at the time of placement and the first growing season. Temporary irrigation can be very effective during establishment. In addition to sprouting and revegetating the site, the placement of the wattling bundles along the contours can reduce slope lengths which can provide long, uninterrupted paths for surface runoff. The rows of wattling bundles act as small sediment traps and increases the amount of infiltration on site. Thus, wattling should not be prescribed as a treatment on cut banks with shallow soils. The increased infiltration will saturate the subsoil and may lead to soil slippage and landslides.

METHODS AND MATERIALS

The following steps for preparing and placing the wattling bundles are recommended:

1. Wattling bundles should be prepared from living branches of willow (Salix spp.) within or near the project area. Willow is the ideal material because it sprouts and roots easily, branches are long, straight, and flexible. Wattling material can be cut with lopping shears, chain saws, or power brush cutting saws.

2. Wattling bundles may vary in length, depending on the material available. Bundles 5 feet long are the easiest to work with. Bundles shall taper at the ends and shall be 1 to 1/2 feet longer than the average length of stems used to achieve this taper. The butts of individual stems shall not vary more than one half inch in diameter.

3. Stems shall be placed alternately (randomly) in each bundle so that approximately one-half of the butt ends are at each end of the bundle.

4. When compressed firmly and tied, each bundle shall be approximately eight inches in diameter.

5. Bundles shall be tied on not more than 15 inch centers with two wraps of binder twine or heavier tying material with a nonslipping knot.

6. Bundles shall be prepared in advance of placement and kept covered and wet. They may be prepared up to seven days in advance of placement.

7. Grade for the wattling trenches shall be staked with an Abney level, or similar device, and shall follow slope contours (horizontal).

8. Trenches shall be three feet vertical spacing (or such other spacing specified. Economics may dictate wider placement).

9. Bundles shall be laid in trenches dug to approximately one-half the diameter of the bundles, with ends of bundles overlapping at least 12 inches. The overlap shall be as long as necessary to permit staking as specified below.

10. Bundles shall be staked firmly in place with vertical stakes on the down-hill side of the wattling. Vertical stakes should be spaced not more than 18 inches on center and diagonal stakes through the bundles on not more than 20 inch centers (See Figure 3-1). Where bundle overlap occurs between previously set bottom or guide stakes, an additional bottom stake shall be used at the midpoint of the overlap. Bundle overlaps shall be "tied" with a diagonal stake through the ends of both bundles.

11. Stakes may be made of live wattling material greater than 1 1/2 inches in diameter or they may be construction stakes (1" x 2" x 24" or 1" x 2" x 36"). Reinforcing bar may be substituted only as specified below.

12. All stakes shall be driven to a firm hold and a minimum of 18 inches deep. Where soils are soft and 24 inch stakes are not solid (i.e. if they can be moved by hand), 36 inch stakes shall be used. Where soils are so compacted that 24 inch stakes cannot be driven 18 inches deep, 3/8 - 1/2 inch steel reinforcing bar shall be used for staking.

13. Work shall progress from the bottom of the cut or fill toward the top and each row shall be covered with soil and packed firmly behind and on the uphill side of the wattling by tamping or by walking on the wattling as the work progresses or by a combination of these methods.

14. The downhill "lip" of the wattling bundle shall be left exposed when staking and covering are completed. However, the preceding specification must be rigorously adhered to.

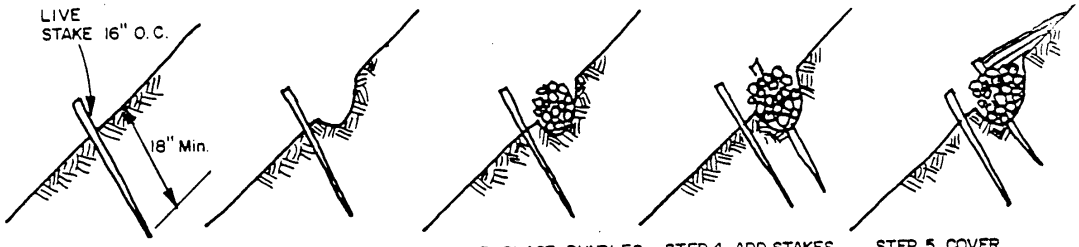
MAINTENANCE

Regular inspection and maintenance of wattling installations should be conducted, especially during the first year and after each precipitation or storm event. Any stakes or bundles which have worked out of the ground should be repaired immediately. Some areas of the slope may slough and lead to gully formation. Immediate repair of any failures is essential to prevent major problems from developing.

EFFECTIVENESS

Wattling is very effective if properly installed according to the design criteria. The wattle bundles will sprout and root, binding the soil with roots and protecting the surface with the above-ground parts. Wattling is a labor intensive practice.

WATTLING
FIGURE 3-1



STEP 1. STAKE ON CONTOUR

STEP 2. TRENCH ABOVE STAKE, 1/2 DIA. OF BUNDLES. CAST SOIL FROM TRENCH DOWNHILL

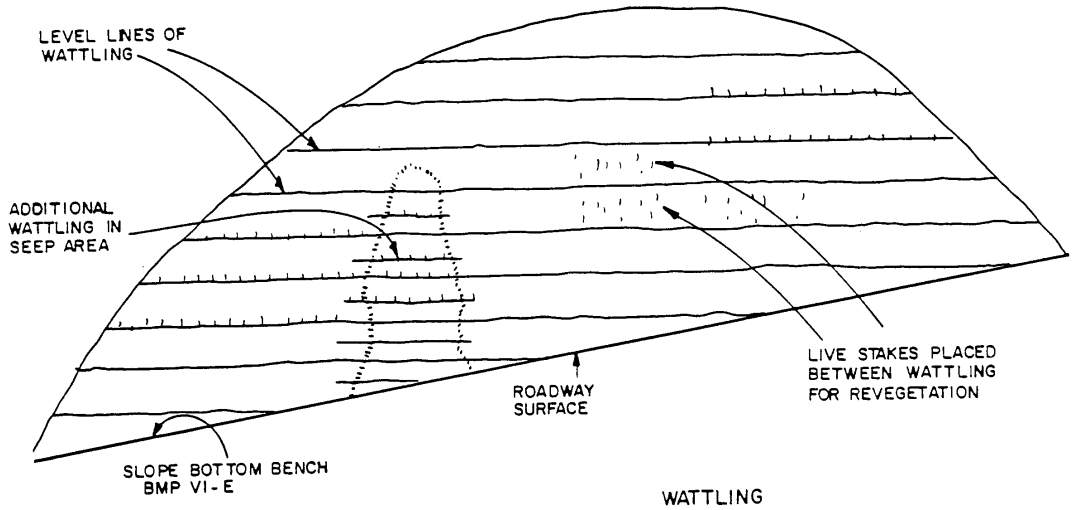
STEP 3. PLACE BUNDLES IN TRENCH

STEP 4. ADD STAKES THROUGH AND BELOW BUNDLES.

STEP 5. COVER WATTLING WITH SOIL, TAMP FIRMLY

NOTE 1. WORK FROM BOTT TO TOP OF CUT OR FILL
2. WALK ON BUNDLES TO COMPACT OVERLAY SOIL
3. STAKES SHOULD BE LIVE WATTLING MATERIAL
4. SPACING OF ROWS SHALL BE DETERMINED BY BMP IV-B

PREPARE WATTLING: CIGAR-SHAPED BUNDLES OF LIVE BRUSH WITH BUTTS ALTERNATING, 8-10" DIA., TIED 12-15" O.C. SPECIES WHICH ROOT ARE PREFERRED.



WATTLING

BMP 3-3
BRUSH LAYERING

DEFINITION

Brush layering consists of embedding tree branches of shrub or tree species, preferably those that will root, such as willows, on horizontal rows or contours in the face of a slope.

PURPOSE

To stabilize cut or fill slopes, to stabilize the soil surface, to reduce the velocity of surface runoff, to trap sediment, to increase infiltration, and to establish vegetation.

APPLICABILITY

Applicable to newly constructed cut or fill slopes or as a reclamation measure for seriously eroded and barren slopes. Slope lengths can be interrupted by rows of brush layering. The method is not applicable on very steep slopes. As a type of revegetation, brush layering is most applicable on moist sites or seeped areas.

PLANNING CRITERIA

Brush layering is a valuable method to achieve slope stabilization on cut or fill slopes or to reclaim seriously eroded or barren slopes. The method can be viewed as a combination of vegetative and mechanical means for slope stabilization. The brush layers can root and vegetatively stabilize the soil surface as a revegetation planting. The woody branches are also used as the soil stabilizing and reinforcing material. The placement of the brush layering along the contours can reduce slope. The rows of exposed branches act as small sediment traps and increase the amount of infiltration on site.

Brush layering has been used successfully in repairing partial fill slope failures. The slope angle may have to be decreased to the angle of repose, and the toe of the slope reconstructed with properly designed retaining structures.

METHODS AND MATERIALS

The following steps for brush layering are recommended:

1. Obtain willow cuttings from on-site or as close to the site as possible.

2. The brush branch (cutting) length should be three to five feet long.

3. The cuttings should be 3/4 to 2" in diameter.

4. The cuttings should be placed perpendicular to the slope and more or less randomly with some criss-crossing of stems.

5. The butt ends of the cuttings should angle down slightly into the slope.

6. The tips should be allowed to protrude beyond the face of the slope at least 1/4 the length of the cutting. For example, cuttings of four feet would have three feet buried and one foot exposed.

7. Vertical spacings between rows of brush layering are dictated by the erosion potential of the slope. In general, the spacings are closer at the bottom and increase up the slope. For example, spacings of four feet near the bottom could increase to eight feet at the top of the slope.

MAINTENANCE

Regular inspection and maintenance of brush layering installations should be conducted, especially during the first year and after any precipitation or storm event. Any slump areas need to be repaired immediately in order to prevent gully formation.

EFFECTIVENESS

Brush layering is very effective if properly installed according to the design criteria. The cuttings will sprout and root, binding the soils, filtering sediment from slope runoff, holding sediment on slope, and protecting the surface. Brush layering is usually more costly than wattling because of the larger amount of excavation, but is the better alternative on old fills or eroding slopes.

BMP 3-4
BRUSH MATTING

DEFINITION

Brush matting is a mulch of hardwood brush species, preferably those that will sprout and root, such as willows, and fastened down with stakes and wire.

PURPOSE

To provide bank protection along streams.

APPLICABILITY

Applicable as a stream bank protection measure. It is usually used in conjunction with other erosion control measures, such as bank reconstruction, rock riprap, and planting.

PLANNING CRITERIA

Brush matting can provide a certain amount of stream bank protection and erosion control. It is usually used in conjunction with other measures. Like brush layering, the method can be viewed as a combination of vegetative and mechanical means for bank stabilization. The brush mats can sprout and vegetatively stabilize the bank surface as a vegetation planting. The mats can also serve as reinforcing material to stabilize the banks.

Brush matting is usually installed above the low-water line. The toe of the bank may be riprapped and the mats placed above. The seasonal water will promote rooting and sprouting of the mats, whereas if the mats are submerged they will not usually sprout.

METHODS AND MATERIALS

The following steps for brush matting are recommended:

1. Obtain willow cuttings from on site or as close to the site as possible.

2. The cuttings should be at least one inch thick.

3. The brush mat should be placed over exposed banks as soon as any bank reconstruction or grading is completed.

4. If the design calls for planting, it is preferable to plant first and then place the brush mats.

5. The brush is laid shingle-fashion with the but-ends pointed upstream. The brush should be trimmed, if necessary, to lie flat on the bank forming a tight mat.

6. The brush mat should be 4 to 18 inches thick, depending on stream discharge and bed load.

7. The brush mat must be secured so that it will not float away. Stakes and/or netting may be necessary.

MAINTENANCE

Regular inspection and maintenance of brush matting installations should be conducted especially during the first year and after any precipitation events. Areas where scouring or undercutting have occurred must be repaired immediately. Any floating material must be removed in order to prevent downstream plugging.

EFFECTIVENESS

Brush matting can be very effective if properly installed according to the design criteria. The mats will sprout and root, binding the soil with roots, filtering sediment from the stream flow, and protecting the soil surface. Brush matting is labor intensive, but may be more cost effective than pure mechanical treatments.

BMP 3-5
WINDBREAKS

DEFINITION

Windbreaks are barriers used to reduce and redirect wind, typically consisting of trees and shrubs, but may also consist of perennial or annual crops, grasses, fences, or other structures.

PURPOSE

To reduce or redirect wind speed which results in a modification of the environmental conditions or microclimate in the sheltered zone.

APPLICABILITY

Windbreaks are applicable wherever a reduction or redirection of winds is desired. The resulting reductions in wind speed lead to microclimate changes which create desirable environments for growing crops, raising livestock, reducing snow drifting and protecting living and working areas. Windbreaks decrease wind speeds which reduces heating fuel costs in the winter and provide shade in summer reducing cooling costs.

PLANNING CRITERIA

The planning of an effective wind break involves the windbreak height, the density of the windbreak, orientation and the effective length. Windbreaks should be designed to meet the specifics of the site, the goals and proposed uses within the resulting protected area and associated planting and maintenance costs. While vegetative plantings, utilizing trees, shrubs and grasses provide additional benefits besides functioning as a windbreak, the specifics of the site may require a structural approach such as fences or walls. Vegetative plantings may be utilized in conjunction with structural approaches in an effective manner.

On the windward side of a windbreak, wind speed reductions are measurable upwind for a distance of 2 to 5 times the height of the windbreak. On the leeward side, wind speed reductions occur up to 30 times the height of the windbreak, downwind of the barrier. Windbreak density is the ratio of the solid portion of the barrier to the total area of the barrier. Wind flows through the open portions of a windbreak, thus the more solid a windbreak, the less wind passes through. By adjusting density different wind flow patterns and areas of protection are established (Table 3-1). A windbreak density of 40 to 60 percent provides the greatest downwind area of protection and provides excellent soil erosion control.

The number of rows, the distance between trees, and species composition are factors controlling windbreak density. Increasing the number of windbreak rows or decreasing the distance between trees increases density and provides a more solid barrier to the wind. Windbreaks with four or five rows are commonly used to protect farmsteads or livestock. Greater width may be necessary in northern climates for wildlife protection. For example eight row windbreaks have been utilized for wildlife protection in Minnesota and one to three row windbreaks are commonly use farther south in areas such as the Texas panhandle.

Windbreaks are most effective when oriented at right angles or perpendicular to prevailing winds. The purpose and design of each windbreak is unique, thus the orientation of individual windbreaks depends on the design objectives. Although the height of a windbreak determines the extent of the protected area downwind, the length of a windbreak determines the amount of total area receiving protection. For maximum efficiency, the uninterrupted length of a windbreak should exceed the height by at least 10:1. This ratio reduces the influence of end-turbulence on the total protected area.

Plant species selection is also important and proper selection will result in not only a functional windbreak but a more natural look and provide excellent wildlife habitat. A row of short shrubs on the outside windward side will trap snow and improve wind protection near the ground. Alternate trees, both large deciduous and conifers with taller shrubs in slightly staggered rows depending upon the density desired. Typically, conifers should occupy windward side with large deciduous in the middle and then tapering down with small deciduous to shrubs on the leeward side.

METHODS AND MATERIALS

A successful windbreak planting depends on proper establishment and care during the first few years after planting. Time spent in site preparation, weed control, and replanting is repaid many times during the lifetime of the windbreak. Each windbreak is unique and your windbreak should be designed for your site and objectives. Assistance in windbreak design and installation is available from the Nevada Division of Forestry, the USDA Soil Conservation Service and the University of Nevada Extension Service. The primary components of designing and installing a windbreak include the following.

1. The windbreak design should be customized to the actual site including buildings, roads, fields, ditches, and utilities.

2. Proper site preparation includes soil types and testing, existing vegetation, rodent control, erosion hazards and weed control.

3. Proper plant material selection includes suitability for the soils of the site, environmental extremes, available moisture and/or irrigation, disease and insect resistance, and purchasing of stock from a reliable source. **Professional expertise is recommended**.

4. Utilize proper planting techniques which meet the needs of the selected plant materials size and location.

5. Maintenance of a windbreak requires weed control, prevention of livestock and/or wildlife damage, insect and disease prevention, adequate irrigation and replanting.

MAINTENANCE

Regular inspection and maintenance should be conducted throughout the plant material establishment period, especially during the first few growing seasons. Irrigation systems and fencing should be well maintained. Replanting should be conducted as necessary.

EFFECTIVENESS

Windbreaks, when properly designed, installed and maintained are effective means for creating microclimates conducive to many human activities. Windbreaks will increase relative humidity, reduce evaporation and heat loss, increase energy efficiency, improve air quality and reduce soil erosion.

TABLE 3-1

OPEN WIND SPEED 20 MPH DECIDUOUS 25%-35% DENSITY

H distance from windbreak	5H	10H	15H	20H	30H
miles per hour	10	13	16	17	20
% of open wind speed	50%	65%	80%	85%	100%

OPEN WIND SPEED 20 MPH CONIFER 40%-60% DENSITY

H distance from windbreak	5H	10H	15H	20H	30H
miles per hour	6	10	12	15	19
% of open wind speed	30%	50%	60%	75%	95%

OPEN WIND SPEED 20 MPH MULTI ROW 60%-80% DENSITY

H distance from windbreak	5H	10H	15H	20H	30H
miles per hour	5	7	13	17	19
% of open wind speed	25%	35%	65%	85%	95%

OPEN WIND SPEED 20 MPH SOLID FENCE 100% DENSITY

H distance from windbreak	5H	10H	15H	20H	30H
miles per hour	5	14	18	19	20
% of open wind speed	25%	70%	90%	95%	100%

NON-VEGETATIVE

BMP 3-6
ROCK & GRAVEL MULCHES

DEFINITION

The application of gravel or crushed rock as a mulch.

PURPOSE

To stabilize soils during construction activities, for other temporary periods, and for permanent erosion control on a variety of surface disturbance areas.

APPLICABILITY

On construction sites, dirt roads, driveways, other areas of light vehicular activity, and surface disturbance areas. (See Mulch-Guide in Appendix C-1.)

PLANNING CRITERIA

Slopes steeper than thirty percent, (3:1), may require additional sediment and erosion control structures depending on the specifics of the site. Installation and maintenance of gravel or rock mulches require heavy equipment so access should be well planned.

METHODS AND MATERIALS

1. Gravel or rock of approximately 3/4 inch to 1 1/2 inch diameter may be used interchangeably. At least 50 percent of the material should be larger than 3/4 inch in diameter. Apply material in a uniform covering.

2. Application rates should be at least 100 tons per acre, with a minimum acceptable surface coverage of 90 percent. If the material used does not supply 90 percent coverage at 100 tons per acre, the application rate should be increased.

3. Upon completion of activities on the site, the gravel or stone mulch may be left in place during revegetation operations.

4. When used for driveways or dirt roads, a filter blanket should be placed under the gravel.

MAINTENANCE

After the gravel or rock is applied, construction or other traffic may move over it. Areas which become compacted or depressed should be remulched to the same level as the remaining area to prevent flows from becoming channelized into these depressions.

EFFECTIVENESS

Rock or gravel mulches retain their effectiveness indefinitely if properly applied, protected from compacting traffic and regular maintenance is conducted.

BMP 3-7
WOOD CHIP, STRAW & BARK MULCHES

DEFINITION

Wood chips, straw and bark mulches are used as mulch in landscape areas as ornamental decoration, soil stabilization and areas recently seeded.

PURPOSE

To protect the soil surface from raindrop and irrigation impact, to create a micro-environment, to increase infiltration, to conserve moisture around tree and shrub plantings, to prevent soil compaction or crusting, and to decrease runoff.

APPLICABILITY

Bark and wood chip mulches are applicable to any landscape area where trees and shrubs have been planted. Straw mulch is utilized in new seedings to create a micro-environment, protect the soil surface and improve seed germination.

PLANNING CRITERIA

Wood chips can be produced on-site by processing tree trunks, limbs, and branches in a wood chipper. Chips should range in size from 1/2 to 3-inches in length, 1/2 to 1-1/2-inches in width, and 1/3 to 1/2-inch in thickness. Chips produced from tree trimmings with significant quantities of leaves or small twigs are not effective as mulch. Straw mulches are widely used in revegetation projects. Straw must be anchored to the soil by one or more of the following methods to prevent wind blowing.

- Crimping, rolling, disking, or punching;
- Covering with netting; or
- Spraying with a chemical or tackifier.

The steeper the slope or in wind prone areas, the greater the need for anchoring the straw. Bark requires a large tree source for on site processing or it can be purchased in varying sizes. The larger sizes, greater than six inches, withstands wind and is not as likely to move.

METHODS AND MATERIALS

Wood or bark chips may be processed from any clean, green, soft wood. A permeable landscape cloth should be placed over the soil surface and the chips blown or spread by hand to a uniform thickness which fully covers the project area. Excess chips can be safely returned to the undisturbed forest floor to supplement existing organic cover. Chips should not be used on decomposed granite slopes over 30%.

Only clean wheat, barley, oat or rice straw should be utilized to prevent the spread of noxious weeds. Straw can be blown on or applied by hand to a uniform depth of approximately two inches or approximately two tons per acre. The straw must be anchored by an appropriate method immediately after application. Slopes steeper than 3:1 and areas adjacent to streams or drainages should be netted to prevent sliding of material and material entering the water course.

MAINTENANCE

Mulched areas must be regularly inspected for damage and remulched as necessary. Inspections and repairs should also be conducted after precipitation or storm events.

EFFECTIVENESS

Wood chip and bark mulches deteriorate slower than the wood fiber in hydromulches and, therefore, retain their effectiveness longer. Wood chips and bark are heavier than straw and less subject to removal by wind. Straw mulch is very effective if it is applied, anchored and maintained properly.

BMP 3-8
JUTE & SYNTHETIC NETTING

DEFINITION

Netting manufactured from a variety of materials typically comprised of squares, approximately one inch in size.

PURPOSE

The primary purpose of nettings is to anchor mulch in place on varying topography or in wind prone areas. Netting provides stability to surface disturbances and reduces the soil erosion potential.

APPLICABILITY

Netting is applicable to any situation that straw or wood chip mulch is utilized. Typical applications include: revegetation of surface disturbances, road cut and fill slopes, ski slopes, mine reclamation sites, etc.. Netting can be utilized in both temporary and permanent applications.

PLANNING CRITERIA

Jute netting is manufactured from heavy jute fiber yarn and woven into approximately one inch square netting. Synthetic netting are manufactured from a variety of plastics and nylon materials with varying strengths. The appropriate netting should be selected for the specifics of the project site. Nettings require anchoring to the slope with either wood stakes or "U"-shaped wire staples per the manufacturers specifications. Netting is quite versatile and can be used on steep slopes, can be seeded, fertilized and hydromulched through, it can stabilize bare soil and sand and can secure mulch or containerized plantings.

METHODS AND MATERIALS

1. Seed and/or mulch the disturbed area.

2. Starting above the mulched and/or seeded area, anchor the top end of the netting by burying it in a trench at least four inches deep by eight inches wide; backfill and compact the excavated material into this trench.

3. The netting should extend beyond the edge of the mulched or seeded area at least one foot on the sides, and three feet at the top and bottom. Fasten with a row of wire staples on one foot centers.

4. Roll the netting out, perpendicular with the slope and secure with staples on three foot centers. The "U"-shaped staples should be six inches to ten inches long, with a one inch crown. Longer staples should be used in loose or sandy soils.

5. Overlap netting at least one foot on the sides and secure with staples on one foot centers along the overlap.

6. Overlap the lower end of the uphill strip over the downhill strip at least one foot and secure with staples on one foot centers.

7. Continue adding strips of netting until the entire mulched area is covered and secured with staples.

8. The netting should be cut to fit around protruding rocks or other large objects, and tucked in around smaller rocks or objects to prevent "bridging".

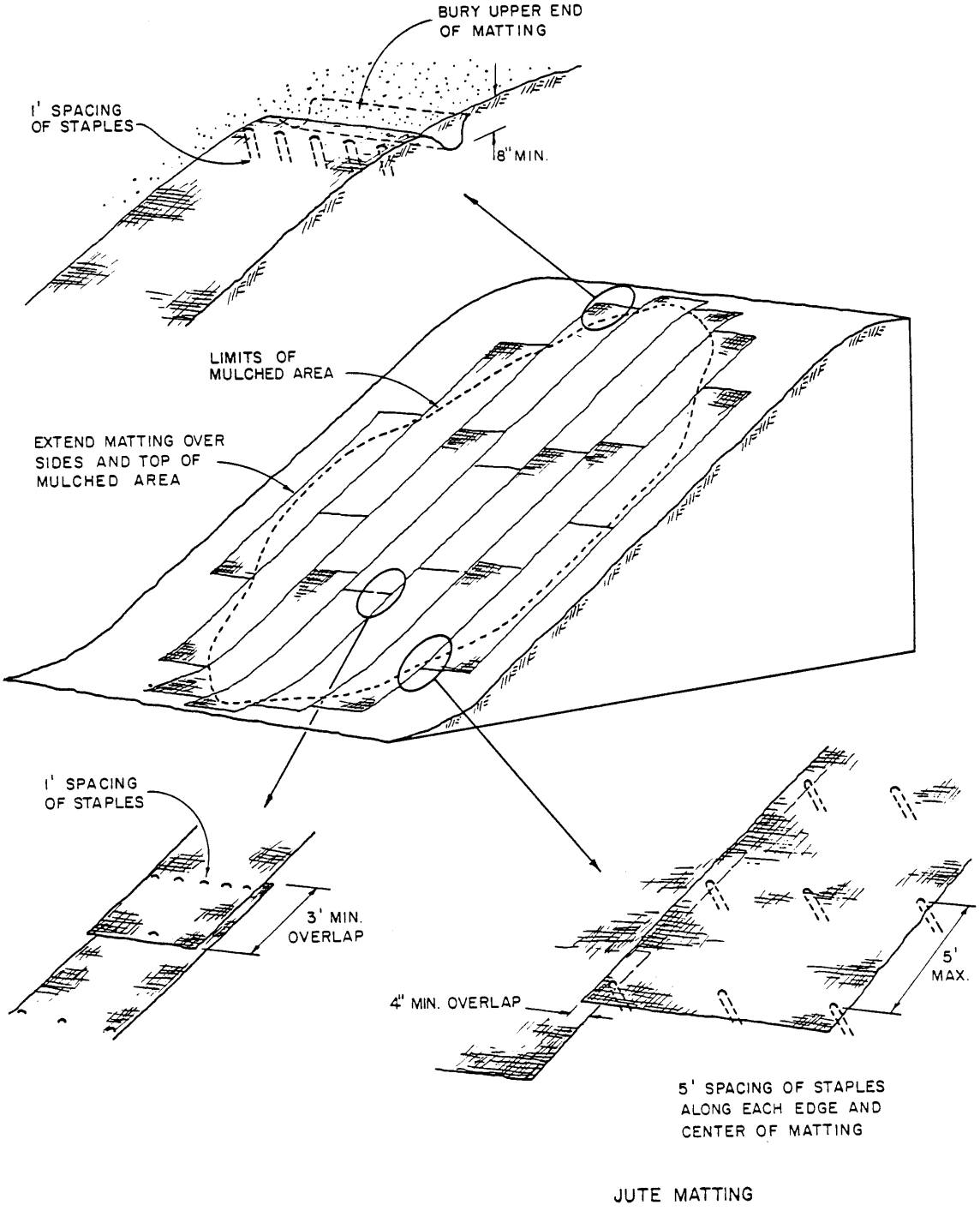
MAINTENANCE

If the netting is properly installed, little maintenance is required. The netted areas should be periodically inspected, particularly after precipitation and storm runoff events. Damaged netting should be repaired and restapled immediately.

EFFECTIVENESS

When installed and maintained properly, nettings are very effective in soil stabilization, revegetation and securing mulches.

JUTE MATTING
FIGURE 3-2



JUTE MATTING

BMP 3-9
SLASH MANAGEMENT

DEFINITION

The scattering of downed and dead tree limbs, shrubs and other woody materials for soil stabilization applications.

PURPOSE

To stabilize the soil surface of disturbed sites of less than 3:1 slope, to reduce the velocity of surface runoff, to trap sediment, to increase infiltration and moisture retention, and to improve seeded vegetation.

APPLICABILITY

Applicable to new surface disturbances where woody vegetation remains or is readily available. The method is not advised on slopes steeper than 3:1. Slash management can also be utilized in conjunction with other reclamation treatments for eroded or barren slopes.

PLANNING CRITERIA

Slash or woody plant materials can be utilized as an effective means of soil stabilization. The practice must consider the specifics of the site including slope, aspect, soils, elevation and precipitation. Generally the practice is most effective on flat grades to gentle slopes. Slash piles should be well scattered to minimize shading and increase effectiveness. Exposed branches will act as small sediment and moisture traps which will increase infiltration. Highly erodible soils and/or steep slopes may result in slash movement, thus compromising its effectiveness. The potential for wildland fire, given the amounts of slash, should also be considered.

METHODS AND MATERIALS

Based upon the specifics of the site, reclamation and/or revegetation treatments proposed and the amount of slash available determine a quantity to be applied. Slash should consist of woody plant materials, typically tree limbs and shrubs. Whole trees should be cut up into manageable pieces, approximately 3 to 5 feet long and no larger than 6 inches in diameter. Larger pieces should be removed from the treatment area.

Slash must be scattered evenly, avoiding excessive ground shading or piles. Slash should be kept out of stream or runoff channels. Butt ends of limbs should angle down slope and be scattered

randomly. Additional information regarding the utilization and disposal of slash associated with timber operations is contained in Appendix H, Forest Resource Management or by contacting the Nevada Division of Forestry.

MAINTENANCE

Regular inspection, monitoring and maintenance is critical to the success or failure of slash applications, particularly after precipitation or storm events. Identified damage or concerns should be addressed immediately and appropriate remedial measures taken as necessary.

EFFECTIVENESS

The use of slash has proven effective under specific natural resource management situations. When properly planned, designed, implemented and followed up, slash management is an effective soil stabilization tool which can, in some situations, reduce long term erosion and sediment transport and improve revegetation efforts.